INDOOR AIR QUALITY ASSESSMENT

EOHHS Service Center
Shetland Park Office Complex
45 Congress Street
Salem, MA

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
August 2017

Background

Building:	Executive Office of Health and Human Services (EOHHS) Service Center
Address:	45 Congress Street, Salem, MA
EOHHS Project Manager:	Sharlene Sharif Field Operations Unit – EHS Facilities
Reason for Request:	Roofing tar odors
Dates of Assessment:	March 1 and March 2, 2017
Massachusetts Department of Public Health/Bureau of Environmental Health (MDPH/BEH) Staff Conducting Assessment:	Mike Feeney, Director, Indoor Air Quality (IAQ) Program Jason Dustin, Environmental Analyst, IAQ Program
Building Description:	Single-story constructed Mid 1800's, recently renovated office space
Building Population:	Approximately 140 employees and over 400 daily visitors
Windows:	Not openable

Methods

Please refer to the IAQ Manual for methods, sampling procedures, and interpretation of results (MDPH, 2015).

IAQ Testing Results

The following is a summary of indoor air testing results (Table 1).

- ***Carbon dioxide levels*** were above 800 parts per million (ppm) in the majority of areas assessed, indicating inadequate fresh air in the space. This is discussed further under the "Ventilation" section of this report.
- ***Temperature*** was within the recommended range of 70°F to 78°F in all areas assessed.
- ***Relative humidity*** was within or just below the recommended range of 40% to 60% in areas assessed.
- ***Carbon monoxide*** levels were non-detectable (ND) in all areas assessed.

- ***Fine particulate matter (PM2.5)*** concentrations measured were below the National Ambient Air Quality Standard (NAAQS) level of 35 micrograms per cubic meter ($\mu g/m^3$) in all areas assessed.
- ***Total Volatile Organic Compounds (TVOCs)*** were ND in all areas tested.

Ventilation

Air handling units (AHUs) are mounted above the ceiling tiles and provide fresh air to office space via air intakes ducted to the roof. AHUs are connected to ceiling-mounted supply diffusers and return/exhaust vents via ductwork. To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate *continuously* during periods of occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. Fresh air ventilation was temporarily disabled during the March 1 and March 2 site visits as discussed below under "Roofing Tar Odors".

Roofing Tar Odors/Project Evaluation

As mentioned, the primary reason for this assessment was to investigate complaints regarding roofing tar odors in the office space. At the time of the first assessment on March 1, 2017, roofing tar odors were detected near the "kettle" located outside at the front of the building but no odors were detected in the office areas (Table 1). The kettle is a gas-fired heater that warms the roofing tar to the proper working temperature (Picture 1). It was reported that roofers were only doing small patch work and stripping old roofing during the March 1 assessment and were not applying the roof tar to large sections of roof (Picture 2). Occupants reported that the odors were strong on the day previous to this assessment (February 28, 2017). Some occupants reported headaches, eye irritation and nausea during the previous roof work before BEH was notified of the project.

It should be noted that Shetland Park maintenance staff reported that due to the ongoing roofing project, the fresh air intakes for the AHUs were closed to avoid the entrainment of roofing tar odors (Picture 3). The MDPH typically recommends that all construction work producing strong odors or particulate matter be performed while the building is *unoccupied*. In cases where this work cannot be performed during unoccupied hours, the temporary closing off

of fresh air intake vents near active work zones is a method used to prevent the entrainment of odors and particulate matter. Due to the lack of fresh air intake functionality, the buildup of commonly-found indoor air pollutants may result. This decreased air exchange can be seen with the slightly elevated carbon dioxide levels shown in Tables 1.

In addition to closing fresh air intakes near work zones, a kettle venting apparatus was installed to capture tar fumes from the kettle area and exhaust them above the roof (Picture 4). Occupants reported that this had improved odors in the waiting room and cubicles in close proximity of the kettle at the front of the building. Future adjustments to the venting height may be necessary if fumes are not dispersed adequately. This is due to the tar fumes having a vapor density of approximately five times that of air.

BEH staff returned on March 2, 2017 due to complaints of strong odors in the office space. Mild roofing tar odors were detected on the Massachusetts Rehabilitation Commission (MRC) side of the space, especially near the rear of the building (Table 2). It was reported by MRC occupants that roofing activities were stopped due to high winds shortly before BEH staff arrived to observe conditions. Reports from work being performed earlier in the day were of strong odors in the rear of the building (MRC side) and interview rooms. It is likely that this area is experiencing depressurization due to the restroom and conference room exhaust fans being on and no fresh air being added to the space to balance the negative pressure. This condition may exacerbate odors by drawing makeup air into the space from pathways above the ceiling plenum in close proximity to active work zones.

Roofing tar has a very low odor threshold. Typically, the odor is noticeable at very low concentrations long before it reaches levels of concern. This is due to the sulfur compounds which give the roof tar its characteristic asphalt/tar smell. Overall, typical acute symptoms of higher exposure are headaches, eye irritation, and nausea which should go away after removing the exposure (NIOSH, 2000). Specific medical concerns should be reported to agency managers and these employees should consult their health care providers. The greatest risk of any long-term effects is to the roofing contractors who are exposed to much higher concentrations over long periods of time (NIOSH, 2000). During both the March 1 and March 2 assessments, total respirable particulate (PM 2.5 μm) and total volatile organic compounds (TVOCs) were found to be within acceptable guidelines (Table 1 and Table 2).

On March 2, 2017, BEH sent a letter to EOHHS staff containing recommendations and a proposed mitigation strategy. This letter is attached as Appendix A. As with any construction project that is performed while the building is occupied, communication with the building occupants is vital. A system for logging complaints should be established so that property management and project managers can act quickly to resolve any IAQ issues arising from the work.

There are considerable challenges in providing an effective, site-specific mitigation strategy for this location due to the many complexities involved in its design. Some of these include building design and location, shifting wind directions and difficulty of performing this work during unoccupied hours in a timely manner. However if current mitigation strategies fail to be successful or EOHHS center occupants experience wide-spread symptoms of acute exposure, the property manager should immediately consult an experienced Certified Industrial Hygienist (CIH) to design an alternate site-specific mitigation strategy. Any alternate mitigation strategy should include the provision for restoring fresh air ventilation from a fume-free location (e.g., upwind). This will help to slightly pressurize occupied areas and minimize pollutants from entering the space. Until a successful mitigation strategy is implemented, consider performing the tarring of large sections of roof before and after occupied hours. Delaying the start time and closing earlier may help to extend the daylight hours available to contractors for tarring operations until there is more daylight naturally available later in the spring.

Microbial/Moisture Concerns

Some occupants reported that damaged window seals allow driving rains to penetrate the east-facing windows. Occupants should refrain from storing porous items on the window sills until repairs can be made. Any water-damaged porous (e.g., papers, gypsum wallboard) items should be discarded.

Conclusions/Recommendations

Based on observations at the time of assessment, the following is recommended:

1. MDPH typically recommends performing high odor/particulate-producing renovation activities during unoccupied hours whenever possible.

2. Implement recommendations from the BEH letter that was sent on March 2, 2017 which is included as Appendix A.
3. Provide temporary mechanical means of fresh air to space while fresh air intakes are closed due to roof work. This can be done by use of portable AHUs and flexible ductwork.
4. If initial proposed mitigation strategy fails to be successful or EOHHS managers receive widespread complaints and symptoms of higher roofing tar exposure:
    - Stop performing odorous activities during occupied hours and contract with a Certified Industrial Hygienist (CIH) to design an alternative site-specific mitigation strategy.
    - Shift odorous activities to unoccupied hours and perform other tasks such as roof stripping during occupied hours until a successful CIH strategy can be implemented.
    - Consider altering business hours to extend daylight hours available to contractors for performance of odorous activity (delayed start, early closing) until more daylight is naturally available later in the spring.
5. Consult the attached MDPH guideline "Methods Used to Reduce/Prevent Exposure to Construction/Renovation Generated Pollutants in Occupied Buildings" for general advice on how to mitigate the effects of construction projects (Appendix B).
6. Due to the nature and scope of this project it is strongly recommended that the property manager hire a health and safety firm (industrial hygienist) to closely monitor conditions on site while odorous activities are being conducted. This would ensure that adjustments to control strategies can be readily implemented without long delay and avoid excessive exposure to occupants.
7. Due to the low odor threshold and the typical pathways in older buildings, no mitigation strategy may be 100% effective in eliminating all odors. Thus EOHHS managers should continue to relocate any employees with hypersensitivities to these odors or who may have respiratory conditions (e.g., asthma) until the work is completed. All other employees should be encouraged to take frequent breaks to get fresh air if slight irritation occurs.

8. Specific medical concerns should be reported to managers and these employees should seek the advice of their health care providers.
9. Communication between employees/managers and property managers/contractors is vital during any renovation project. Establish a system where complaints can be reported and addressed promptly.
10. For more information on roofing tar and mitigation strategies please consult: the NIOSH, 2000 report web link in the "Reference" section of this report and "Avoiding Indoor Air Quality (IAQ) Problems During Roofing Projects" a NY state guideline attached as Appendix C.
11. Inspect areas of reported leaking windows at the front of the building. Make necessary repairs and remove any water-damaged porous building materials (e.g., gypsum wallboard).
12. Refer to resource manual and other related IAQ documents located on the MDPH's website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at: http://mass.gov/dph/iaq.

References

MDPH. 2015. Massachusetts Department of Public Health. Indoor Air Quality Manual: Chapters I-III. Available at: http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/iaq/iaq-manual/.

NIOSH. 2000. Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Health Effects of Occupational Exposure to Asphalt. December 2000. https://www.cdc.gov/niosh/docs/2001-110/pdfs/2001-110.pdf

Picture 1

Roofing tar "kettle"

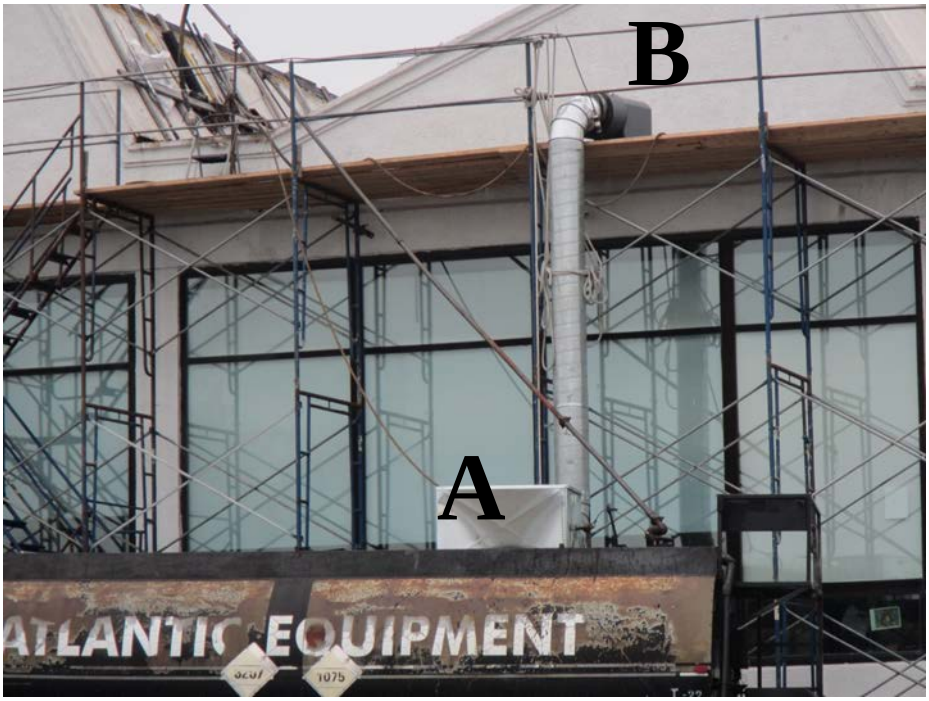
Picture 2

Workers set up to strip old sections of roofing (note completed areas to left)

Picture 3

Fresh air intake (closed) in area of active roof work

Picture 4



Kettle venting apparatus showing collection (A) and venting (B) areas

Location: EOHHS Service Center

Address: 45 Congress Street, Salem, MA

Indoor Air Results

Date: 3/01/2017

Table 1

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	VOCs (ppm)	PM2.5 (µg/m^3)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
Background	318	ND	61	71	ND	16	-	-	-	-	Overcast, wind SSW 9mph, asphalt odor detectable downwind of kettle
Large conference room	858	ND	70	47	ND	4	10	N	Y	Y	
1151	984	ND	73	44	ND	4	0	N	Y	Y	Plants, CP, AHUs reportedly on recirculate only (closed fresh air vents)
1144	929	ND	75	41	ND	3	0	N	Y	Y	
1145 reception	1089	ND	75	41	ND	3	2	N	Y	Y	DEM, CP, HS
1156	973	ND	75	39	ND	3	1	N	Y	Y	HS
1158	942	ND	75	39	ND	3	1	N	Y	Y	HS
1167	910	ND	75	38	ND	2	0	N	Y	Y	
1186	916	ND	75	39	ND	3	2	N	Y	Y	HS, AI, plants
1162	893	ND	75	39	ND	2	2	N	Y	Y	Plants, CP, AI, HS

ppm = parts per million
µg/m^3 = micrograms per cubic meter
AHU = air handling unit
AI = accumulated items
CP = cleaning products
DEM = dry erase materials
HS = hand sanitizer
ND = non detect
PF = personal fan

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferred
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: EOHHS Service Center

Address: 45 Congress Street Salem, MA

Indoor Air Results

Date: 3/01/2017

Table 1 (continued)

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	VOCs (ppm)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
1193	907	ND	74	39	ND	3	1	N	Y	Y	Plants, HS
1202	912	ND	75	39	ND	2	1	N	Y	Y	Plants, windows leak in driving rain
1198	924	ND	75	37	ND	1	1	N	Y	Y	Plants
1207	974	ND	75	37	ND	1	1	N	Y	Y	HS
1179	755	ND	74	36	ND	4	1	N	Y	Y	
1116	948	ND	73	41	ND	2	1	N	Y	Y	
1098	955	ND	73	41	ND	3	1	N	Y	Y	
Forms area	1069	ND	73	42	ND	5	1	N	Y	Y	
1009	1079	ND	73	41	ND	3	0	N	Y	Y	
1090	1067	ND	73	41	ND	2	1	N	Y	Y	

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Indoor Air Results

Date: 3/01/2017

Table 1 (continued)

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	VOCs (ppm)	PM2.5 (µg/m^3)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
Reception	1075	ND	74	42	ND	2	5	N	Y	Y	PF, HS, AI
1063	1070	ND	74	42	ND	1	3	N	Y	Y	
1044	1068	ND	74	41	ND	1	2	N	Y	Y	
1047	1079	ND	74	41	ND	3	2	N	Y	Y	
1071	1109	ND	74	41	ND	2	3	N	Y	Y	
1053	1061	ND	74	40	ND	2	1	N	Y	Y	CPs
1056	988	ND	74	40	ND	3	1	N	Y	Y	
1080	901	ND	74	40	ND	2	2	N	Y	Y	
1101	885	ND	73	40	ND	2	0	N	Y	Y	
1017	887	ND	73	40	ND	2	0	N	Y	Y	

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Address: 45 Congress Street Salem, MA

Indoor Air Results

Date: 3/01/2017

Table 1 (continued)

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	VOCs (ppm)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
1039	911	ND	73	40	ND	4	0	N	Y	Y	
1014	924	ND	73	40	ND	4	1	N	Y	Y	
1035	964	ND	73	40	ND	3	1	N	Y	Y	
1032	992	ND	74	41	ND	2	2	N	Y	Y	
1028	1173	ND	74	41	ND	3	1	N	Y	Y	
1024	1110	ND	74	41	ND	2	0	N	Y	Y	
1021	1109	ND	74	41	ND	3	1	N	Y	Y	
Lobby	1409-2245	ND	74	48	ND	3-5	10-45	N	Y	Y	Morning reading had higher occupancy than afternoon

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Location: EOHHS Service Center **Indoor Air Results**

Address: 45 Congress Street, Salem, MA **Table 2** **Date: 3/02/2017**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	VOCs (ppm)	PM2.5 (µg/m^3)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
Background- outside near kettle	423	0.8	48	12	ND	22-54	-	-	-	-	Strong Westerly winds, asphalt odor
Rt side (MRC) rear hall	844	ND	73	36	ND	4	0	N	Y	Y	Tar odor, all AHU fresh air intakes closed, strong odors reported in morning
1170	865	ND	73	38	ND	3	2	N	Y	Y	Slight tar odor, tar work stopped just before BEH staff arrived
1151 –near window beside kettle	1018	ND	73	38	ND	6	1	N	Y	Y	
1188- middle row	966	ND	74	37	ND	2	1	N	Y	Y	
1183	967	ND	74	37	ND	2	2	N	Y	Y	
1193	956	ND	74	36	ND	2	1	N	Y	Y	Near window
DTA side 1140	1071	ND	74	38	ND	2	1	N	Y	Y	
1135	958	ND	73	36	ND	2	1	N	Y	Y	Slight tar odor
Forms area	958	ND	73	38	ND	3	0	N	Y	Y	

µg/m^3 = micrograms per cubic meter ppm = parts per million ND = non detect AHU = air handling unit

Comfort Guidelines

Carbon Dioxide:	< 800 ppm = preferred	Temperature:	70 - 78 °F
	> 800 ppm = indicative of ventilation problems	Relative Humidity:	40 - 60%

Location: EOHHS Service Center

Address: 45 Congress Street Salem, MA

Indoor Air Results

Date: 3/02/2017

Table 2 (continued)

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	VOCs (ppm)	PM2.5 (µg/m^3)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
1101	762	ND	73	33	ND	3	1	N	Y	Y	
1080	748	ND	73	33	ND	3	2	N	Y	Y	
1050	956	ND	73	38	ND	1	1	N	Y	Y	
1062	978	ND	73	40	ND	4	0	N	Y	Y	Near window
1002	985	ND	73	40	ND	2	1	N	Y	Y	
1008	962	ND	73	40	ND	2	1	N	Y	Y	
1036	921	ND	73	37	ND	1	1	N	Y	Y	
Reception	921	ND	73	40	ND	1	3	N	Y	Y	
Lobby	1477	ND	74	41	ND	3	31	N	Y	Y	

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